

ON A
 SYSTOLIC MURMUR IN THE
 PULMONARY ARTERY,
 AND ITS APPLICATION TO THE DIAGNOSIS OF FUNCTIONAL AND
 ORGANIC MURMURS.

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A murmur heard at the base of the heart may generally be followed for some distance along the ascending aorta, and if loud is prolonged into the innominate and carotid arteries. In some cases, however, a murmur is heard loud at the base, and yet not traceable along the aorta, but clearly audible in a line from the third left intercostal space at the edge of the sternum, towards the middle of the left clavicle for the distance of two to two and a half inches. Or a murmur may be audible in this direction at the same time that it is traceable along the aorta.

The frequent recurrence of a murmur in this situation, at the same time that it attracted my attention, gave the means of solving the questions that arose as to the diagnostic value of such a sign, in what vessel was the murmur situated, and what state of things did it denote? The first question can only be settled by an examination of the phenomena displayed in individual cases; the second by the termination of a number of cases in which these phenomena had been observed.

The line above described corresponds nearly to the course of the pulmonary artery, which forms the arc to this chord, the pulmonary valves lying behind the third left costal cartilage at its junction with the sternum, and the bifurcation of the left branch of the pulmonary artery corresponding, at some depth, to the point at which the above line cuts the lower edge of the second left rib. So that anatomy inclines us to believe (and, as it is established that slow feeble currents vibrate more readily than rapid streams in tense vessels, physiology has nothing to object,) that a murmur in this direction is really situated in the pulmonary artery.

Disease of the pulmonary sigmoid valves is so extremely rare, that we have not the opportunity of verifying our diagnosis in a simple case before the heart is much enlarged, (the patient dying of some other disease,) as can so frequently be done for the aortic sigmoid

valves. The following cases, nevertheless, will throw some light on the subject.

C. W., aged 21, of a pale cadaverous appearance, complaining of pain in the region of the heart, palpitation and great exhaustion, was admitted under the care of Mr Stanley, for a venereal affection in June 1840. She was liable to sudden attacks of syncope, had anasarca and albuminous urine, cough without expectoration, but was quite free from dyspnœa, and lay in the horizontal position during her stay in the hospital, where, after about six weeks' suffering, she died of sudden effusion into the cavity of the pleura, purpurous spots having made their appearance all over the body at the same time.*

On auscultation a loud systolic murmur was heard throughout the cardiac region, most intense on the sternum at the level of the fourth rib, and traceable from thence to either side, louder on the right side, supposed in the course of the aorta. On the left side the murmur was heard diffused over an extended space, but more intense in a line passing outwards from the point before mentioned. This same systolic murmur was audible throughout the lungs posteriorly; and in the neck a venous murmur could be traced.

The sounds became less intense before her death, but in all other respects remained essentially the same. The diagnosis was given of disease of the pulmonary valves, with or without aortic disease; and dissection proved its correctness, all the orifices being found healthy except the pulmonary, where there was most extensive disease.

Her appearance differed remarkably from that of the next patient. The other symptoms and physical signs, however, were much alike in the two cases.

W. C. aged 28, first came, in May 1837, under observation of Dr Bond of Cambridge, to whom I am indebted for the following notes. He was a waterman of temperate habits, subject for the last two years to palpitation, of which he then complained, with a dragging sensation in the epigastrium, and dyspnœa on exertion, but he was able to retain the horizontal position to the last. The surface of the body was of a dusky purple, but he had no notable distension of the superficial veins, nor jugular pulsation. He had anasarca and ascites from time to time, and died gradually with these symptoms in December 1839.

There was dulness on percussion in the region of the heart for a space of two inches square. The heart's impulse was increased and extended. There was a loud harsh murmur nearly synchronous with the systole, loudest and harshest to the left of the sternum in the third intercostal space, but audible all over the cardiac

* The further details of this case have been published by Mr Paget.—*Trans. Med. Chir. Society*, vol. xxvii. pp. 182 et seq.

region and in the epigastrium. The sounds continued audible in the same situation, but not at the same time, till his death; for the murmur after the lapse of a year was found to have become diastolic.

After death the heart was found nearly twice its natural size, and the pulmonary valves agglutinated into a thick cartilaginous ring, leaving a permanent orifice just large enough to admit the passage of an ordinary quill. All the other valves were healthy.

T. B. aged 22, was admitted under the care of Dr George Burrows in July 1845, complaining of pain in the right hypochondrium, anasæra, and ascites, cough and dyspnœa, habitual, but much aggravated during the last eight weeks. His face was dusky and œdematous, but he was reported to be generally free from lividity. He died gradually in the course of the next month with diarrhœa, progressive exhaustion, and loss of heat of the surface.

A well-marked purring tremor was perceptible over all the cardiac region, the heart's impulse was excessive, and there was extended dulness on percussion in the transverse direction. A loud, harsh, double murmur was audible over the whole cardiac region, most intense at the junction of the fourth rib with the sternum, but heard also in the ascending aorta. A loud systolic murmur was audible in the epigastrium, and thence communicated upwards over the region of the right ventricle.

After death the heart was found about twice the natural size. The right side was much hypertrophied. The aorta opened into both the right and left ventricles; the aortic valves were healthy, the mitral, though diseased, apparently efficient. The tricuspid valve was thickly set with globular excrecences, some of which had been ruptured, and the pulmonary valves, of which, as in the case of C. W., there were but two, most extensively disorganized by excrecences of the same kind. The sinus of the pulmonary artery was also dilated. Some freshly deposited fibrin lined the pericardium.

In spite of the complicated nature of this case, a diagnosis was made that the sigmoid valves of the right side of the heart were diseased, whatever further lesions there might be. This diagnosis was founded on the fact of the murmur being audible from the epigastrium over the right ventricle, becoming most intense at the junction of the fourth left costal cartilage with the sternum. The correctness of the diagnosis was shown by dissection.

Leaving out of consideration all the constitutional symptoms, it appears that the most prominent point which these three remarkable cases possessed in common was a loud, widely extended murmur, heard most loudly to the left of the sternum in the third intercostal space, or a little lower. In the absence of other evi-

dence, it cannot be said how much of the murmur in the epigastrium was referable to regurgitation through the tricuspid orifice ; for although this valve was palpably diseased in the last case only, in all the right auricle was dilated. Insisting on what these cases had in common, a correct diagnosis was made in each instance by a different observer. In the absence of all other information on the subject, the results of the observation of these cases would not much aid the diagnosis, but they are very valuable, as showing that the diagnosis can be made by insisting on a small portion even of the evidence which recent cases afford. This evidence is of a character to preclude the possibility of a murmur heard loudest in the direction of, being seated elsewhere than in, the pulmonary artery, while the facts elicited by observation of actual disease of the pulmonary valves add, so far as they go, their positive to the masses of negative testimony.

The next case throws some light on the further direction of the current of blood producing a murmur in the course of the pulmonary artery. G. H., aged 22,* a tall delicate looking young man, under treatment for an abdominal affection, presented on auscultation a distinct diastolic murmur, musical in the course of the pulmonary artery, then soft and blowing as it crossed obliquely from the left to the right side of the sternum, and finally lost in the region of the right ventricle. This case proves that the current of blood which produces a murmur in the line described runs in the direction of the right ventricle. A systolic murmur, which only commences at the pulmonary orifice, cannot supply this link of evidence.

In the absence of any dissection, for the case did not terminate unfavourably, it is impossible to say that there was not here some abnormal position of parts. The experience of any auscultator will inform him, without needlessly lengthening this essay by quoting such cases, how far the situation here pointed out differed from that where murmurs referable to the aortic or auriculo-ventricular valves are usually audible ; and as far as a systolic murmur is concerned, that this may be heard in the course of the pulmonary artery where no deviation from the normal position exists, was shown by the dissection of a patient who sunk after amputation, in whom there had been a murmur audible in that situation for some days before his death. There are no grounds, then, for presuming, without positive evidence, that murmurs in this situation are referable to the aorta in an altered position ; and as far as auscultation can show the aorta and all the heart to be normally situated, the evidence is conclusive that they are so.

For a murmur may be heard in the aorta in numerous cases, loud and distinct in all its details, where no murmur is audible in the direction of the pulmonary artery at all. Conversely, a

* See the parallel case of Edmond Rogers. Hope on the Heart, 3d ed. p. 599.

murmur may be heard in this direction where there is none in the aorta, as occurred in cases 2 (3), 4 (30), 5 (19), 7 (3), 11 (11), 12 (27). Moreover, a during murmur in the aorta may be accompanied by a musical murmur in the direction of the pulmonary entry, as in case 18 (28), not to mention other slighter differences in character, as in cases 17 (2), 19 (40), and the varying degrees of intensity so frequently noticed in the tables as occurring in the two situations.

The conclusion is briefly this,—that murmurs which rise and fall in intensity, quite irrespective of each other, which are of different characters, and may exist mutually independent of each other in their appropriate situations, cannot be referable to the same cause; and this the more evidently, as there is a cause in operation in each situation notoriously capable of producing these murmurs in one as much as in the other. We refer one set to the aorta, the other, on the same grounds, to the pulmonary artery.

Not to overload the present subject by considering difficulties which can never arise, we may omit all mention of murmurs at the apex, and notice only murmurs in the innominate veins to show that “a loud continuous hum heard in the jugulars, and prolonged beneath the clavicles in the direction of the innominate veins,” could, were it even otherwise than extremely rare, give rise to no error in diagnosis.

On this foundation we would rest the assertion that a murmur heard loudest in the situation so often alluded to is to be referred to the pulmonary artery. It remains to investigate the nature of the cases in which this murmur is generally audible.

For this purpose the results of the auscultation of thirty-two cases have been registered in a tabular form. In all of these, at one time or other, a murmur was plainly distinguishable in the pulmonary artery. They were for the most part recent cases, in which, putting aside all question as to the original cause of the affection, the physical examination could give no certain information as to the existence of any organic lesion of the heart. For the prognosis, then, in one point of view, they are unexceptionable, at the same time that the simplicity of the cases renders the diagnosis less exposed to errors of observation. Had a record been preserved of all the cases examined in the collection of these clearly distinguishable murmurs in the pulmonary artery, some more satisfactory information might have been furnished as to the proportion of cases in which a murmur is audible in this situation.*

* Of 27 consecutive cases of chlorosis and its kindred maladies,

8 had murmurs at the apex.

22 { 15 in the aorta.
19 in the pulmonary artery. } base.
19 out of 21, in the jugular veins.

It is necessary to add, that not more than 3 or 4 of these cases were used for the formation of the tables accompanying this essay.

They are divided into two series, the first containing those cases in which one or more murmurs disappeared; the second, those in which all the murmurs remained audible so long as the patients continued under observation.

The first column contains the number by which the case is referred to, with the name, age, and name of the disease of the patient, and the number of days over which the observation extends subjoined, and the date of each examination recorded during that period. Of the examinations made previous to the development of a murmur, or after their entire removal, no mention is made here, though such examinations, especially those confirmatory of the removal of the murmurs, frequently were made.

For brevity, as well as for convenience of reference, the existence of a murmur in any situation is denoted by the name merely of that situation, which also is expressed by an abbreviation, and where not otherwise stated, the murmur is to be understood as having been audible with the systole only.

First series of cases presenting murmurs in the pulmonary artery, containing those in which one or more of the murmurs audible in the region of the heart were removed.

1 Sarah Crawley, 24, acute rheum. 14 days.	1 Base, not beyond. 9 Pulmonary artery only. 14 No murmur any where.
2 M. A. Poole, 20, anæmia. 6 days.	1 Base and apex. 3 Pulmonary artery. Aorta none. Apex faint. 5 Base none. Apex faint. 6 Base none. Apex none.
3 Wm. Smith, 15, anæmia, fever. 16 days.	1 Aorta. Pulm. artery short. Apex. No vens. mur. 3 Aorta. Pulmonary artery more intense. 13 Aorta loud and blowing. Pulmonary artery less so. Apex fainter. 16 No murmur. Systole ringing but clear.
4 Sarah Pickett, 17, acute rheum. About 2 years.	1 Murmur in aorta and pulmonary artery. 30 Aorta none. Pulmonary artery. No murmur any where.
5 Wm. Stockham, 24, acute rheum. 52 days.	1 Base somewhat masked by a friction sound. 3 Base as before. 4 Base. Apex. 5 Base. Apex. 19 Pulm. art. loud, harsh. Aorta none. Apex blowing. 52 No murmur anywhere.
6 Sarah Mountney, 23, acute rheum. 64 days.	1 Base loud, harsh. Apex faint. 2 Pulm. art. loud, harsh. Aorta faint. Apex soft. 3 } 4 } 6 } Same sounds on auscultation. 8 } 9 } 14 Base faint. Not prolonged into aorta. Venous murmur. Apex not examined. 15 Sounds generally fainter. 16 Sounds generally louder. 17 Pulm. art. loud. Innomin. art. none. Apex faint.

- 22 Pulmonary artery louder than aorta. Apex. Sounds generally less harsh.
- 28 Same auscultation.
- 36 Base as before. Apex, long systole.
- 43 Base soft. Apex none.
- 57 Base, not beyond.
- 62 Base, not beyond.
- 64 No murmur any where.
- 7 Emma Lawrence, 1 Pulm. art. Aorta none. Apex. Venous mur.
28, acute rheum. 2 Same sounds generally fainter.
21 days. 3 Pulmonary artery soft. Aorta none. Apex rough.
5 Same sounds generally.
6 Do.
7 Pulm. artery and aorta, long systole. Apex harsh.
8 Pulm. art. louder. Aorta as before. Apex fainter.
10 Base faint. Apex faint.
12 Do. do.
13 Do. do.
16 Base long systole. Apex.
17 Do. do.
19 Base as before. Apex not examined.
20 Systole generally prolonged.
21 Base long systole. Apex.
One year after. No murmur any where.
- 8 H. Reynolds, 21, 1 Heart's sounds ringing.
acute rheumat. 2 Base. Apex.
30 days or more. 3 Do. do.
4 No murmur any where.
- 9 Esther Cooksley, 30 Pulmonary artery. Aorta none.
14, rubeola. 10 1 Pulmonary artery louder than aorta.
days. 2 Pulmonary artery as before. Aorta louder.
4 Base, not beyond.
- 10 Sarah Steele, 34, 10 Pulmonary artery. Aorta none.
acute rheumat. 1 Base none. Apex.
18 days. 2 Base none. Apex.
9 Carotids. Apex.
- 11 Henry Brad- 16 Pulmonary artery, (prolonged into the lungs.)
bury, ac. rheum. Aorta and carotids. Apex musical.
11 days. 18 Pulm. art. Lungs. Aorta none. Apex musical.
1 Base soft. Apex none.
2 Base louder. Apex none.
6 Base, and prolonged into the arteries. Vens. mur.
7 Same sounds generally. Apex distinct.
- 12 Maria Brigg, 21, 11 Pulmonary artery distinct. Aorta none. Apex
acute rheumat. faint. Venous murmur.
27 days. 1 Base none. Apex.
4 Base. Apex.
6 No decided murmur anywhere.
8 No murmur.
- 13 Hy. Shepherd, 15 Base none. Apex.
14, fever, rheu- 20 Base doubtful. Apex musical.
matism 6 months 27 Pulm. art. musical. Aorta none. Apex blowing.
- 1 Base feeble. Apex loud.
6 Pulmonary artery. Aorta faint. Apex.
7 Pulmonary artery faint. Apex harsh.
9 Pulmonary artery. Aorta faint. Apex.
10 Pulmonary artery louder than aorta. Apex.
16 Pulmonary artery and aorta louder. Apex.

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| | 20 | Base faint. Apex musical. |
| | 24 | Pulmonary artery and aorta. Apex musical. |
| | 26 | Pulm. artery louder than aorta. Apex musical. |
| 5 months after | 1 | Base none. Apex musical. |
| | 18 | Pulmonary artery. Apex musical. |
| 14 Ellen Howell, | 1 | Base. Apex. |
| 15, fever. 15 days. | 3 | Pulmonary artery. Carotids. Apex. |
| | 4 | Pulm. art. Carotids short and sharp. Apex none. |
| | 15 | Pulm. art. louder than aorta. Venous murmur. |
| 15 Caroline Ran- | 1 | Crackling sound base and aorta. |
| dall, 26, acute | 6 | Same sounds at base. Apex blowing. |
| rheum. 51 days. | 13 | Aorta harsh. Apex blowing. |
| | 17 | Same sounds generally. |
| | 18 | Pulmonary artery louder than aorta. |
| | 23 | Pulmonary artery. Aorta none. Apex none. |
| | 24 | Pulmonary artery and aorta loud. Apex soft. |
| | 26 | Same sounds generally. Venous murmur. |
| | 44 | Sounds generally indistinct. |
| | 54 | No morbid sounds audible, but reproducible on exciting the circulation. |
| 16 Allen Avery, 13, | 1 | Base faint. Apex none. |
| acute rheuma- | 3 | Do. Do. |
| tism. 42 days. | 6 | Do. Apex faint. |
| | 7 | Do. Do. |
| | 8 | Pulm. louder than aorta. Apex faint. No venous murmur. |
| | 10 | Base less definite. Apex. |
| | 12 | Murmurs generally faint. |
| | 13 | Pulm. artery louder than aorta. Apex faint. No venous murmur. |
| | 15 | Pulm. art. Aorta none? Apex none. No ven. mur. |
| | 20 | Do. Do? Apex none? Ven. mur. |
| | 22 | Do. Do? Apex none. No ven. mur. |
| | 27 | Base only on exertion. Apex none. |
| | 30 | Base. Apex none? |
| | 37 | Base none? Apex none. Venous murmur. |
| | 42 | Base none. Apex none? Do. loud. |

It will be seen on examination of these cases that in only 7 out of the 16 were all the murmurs finally removed at the time when the patients passed from under our observation. These are the first seven.

In the eighth case all the murmurs had at one time disappeared, but on her discharge from the hospital she, as well as the next case, presented a murmur in the pulmonary artery, and in this situation only.

In the four next cases (10, 11, 12, 13;) there was a murmur audible at the apex as well as in the pulmonary artery; in the 14th a murmur continued in the aorta as well as in the pulmonary artery; in the 15th a murmur could be heard on exciting the circulation at apex and base, in the pulmonary artery and in the aorta; in the 16th it is quite a question whether there was any cardiac murmurs at all; if so, only at the apex.

So that of the murmurs which continued we have

In 2 cases murmurs in pulmonary artery only,	8, 9.
4 pulmonary artery and at apex,	10, 11, 12, 13.
1 case pulmonary artery and aorta,	14.
1 pulm. artery, aorta, and apex,	15.
1 apex only,	16.

Of the murmurs removed we have to notice their disappearance,

In 8 cases from pulmonary artery,	1, 2, 3, 4, 5, 6, 7, 16.
9 apex,	2, 3, 5, 6, 7, 8, 12, 14, 15.
11 aorta,	3, 4, 6, 8, 9, 10, 11, 12, 13, 15, 16.

And contrasting this with the individual murmurs which remained, namely,

In 8 cases in pulmonary artery,	8, 9, 10, 11, 12, 13, 14, 15.
6 apex,	10, 11, 12, 13, 15, 16.
2 aorta,	14, 15.

we may draw the conclusion, that murmurs in the pulmonary artery take a longer time for their removal than murmurs at the apex, and these than murmurs in the aorta. But it would be hazardous to attempt to draw any further inferences from such small numbers, as any subdivisions of these cases afford, and all that remains to be said on the numerical analysis of this subject will best be deferred till after the consideration of the remaining cases.

The second series contains those cases which presented a murmur in the pulmonary artery, together with other murmurs in the region of the heart, but of which none were removed so long as the patients continued under observation.

17 Harriet Smith,	1 Pulm. art. louder than aorta. Apex. Vens. mur.
23, acute rheum.	2 Pulm. art. loud, ringing. Aorta sharp, blowing.
11 days.	Apex.
	5 Pulm. art. Aorta. Apex. (Soft, blowing in all.)
	11 Pulmonary artery louder than aorta. Apex.
18 Eliza Martin,	1 Base louder than apex.
acute rheum. 55	7 Same sounds generally.
days.	23 Base. Carotids. Apex.
	28 Pulm. artery musical. Right lung blowing. Left lung musical. Aorta and carotids blowing. Apex musical.
	35 Base and apex. Sawing murmur.
	39 Pulm. art. (Aorta faint?) Apex not examined?
	55 Pulmonary artery. Aorta faint. Apex.
19 Mary Wolff, 21,	1 Base. Apex.
acute rheumatism.	2 Pulm. art. Aorta. Apex.
57 days	5 Do. do. do. audible to left of mamma.
	7 Same aus-
	8 cultation
	9 generally.
	10 } Sounds fainter.
	14 Pulmonary artery. Aorta. Apex. Venous mur.
	22 Same auscultation.
	26 Same auscultation, but venous murmur very loud.
	33 Same auscultation as last note.

- 40 Pulmonary art. soft and blowing. Aorta loud and harsh. Apex louder. Venous mur. humming.
 47 Pulm. art. louder than aorta. Apex. Venous mur.
 57 Base less distinct. Apex. Venous murmur.
- 20 Sarah Emmett, 1 Base none. Apex.
 13, acute rheum. 2 Base. Apex harsher.
 76 days. 3 Pul. art. (masked by a friction sound.) Aor. A ex.
 4 Base as yesterday. Apex.
 5 Do. do.
 6 Do. do.
 10 Do. 2d sound dull, do.
 12 Base indistinct do.
 23 Base. Apex.
 26 Do. do.
 29 Pulmonary artery. Aorta. Apex.
 32 Do. do. do.
 38 Do. do. do. Venous mur.
 45 Do. do. do. do.
 46 Pul. artery louder than aorta. do. do.
 52 Do. do. do.
 59 Pulm. art. Aorta faint. Apex loud. do.
 66 Pulm. artery. Aorta. Apex. Venous mur. faint.
 76 Pul. art. louder than aort. Apex. Ven. mur. faint.
- After three months. Base confused. Apex loud and harsh.
- 21 Harriet Guy, 16, 1 Pulmonary artery faint. Aorta loud. Apex.
 acute rheumat. 3 Pulmonary artery louder than aorta. Apex.
 11 days. 4 Pulmonary artery blowing. Apex ringing. (No murmur?) Apex.
 11 Pulmonary artery and aorta equally faint. Apex.
- 22 Ann Guy, 28, 1 Pulmonary artery louder than aorta.
 subacute rheum. 16 Pulmonary artery. Aorta. (Carotids?) Apex.
 16 days.
- 23 Mailsant Mayo, 1 Right lung behind louder than left. Base. Carotids. Apex louder than base.
 10, acute rheum. 3 Pulm. art. louder than aorta. Apex not examined.
 enlarged abdom. 8 } Same auscultation, (murmurs at apex presumed
 16 days. 16 { to be unchanged.)
- 24 Christiana Dawson, 22, effects of 1 Pulm. artery less loud than aorta. Apex blowing,
 old rheumatism. and systolic to right of mamma, musical and diastolic to left of mamma.
 18 days. 7 Same sounds generally.
 18 Same sounds generally.
- 25 Sarah Butterworth, 25, acute 1 Pulmonary artery. Apex none.
 rheumat. 6 days. 2 Pulmonary artery. Apex none.
 4 Pulmonary artery faint.
 6 Pulmonary artery louder than aorta
- 26 Eliz. Harrington, 19, menorrhagia. 16 Pulmonary artery. Aorta. Venous murmur.
 16 days. 16 Pulmonary artery. Aorta. Musical venous murmur in innominata veins. Apex none
- 27 Eliz. Baker, 19, amenorrhœa. 1 Base.
 2 2 Pul. art. Aorta. Carotids. No venous murmur.
 days.
- 28 Ellen Fresbee, 1 Pulmonary artery. Aorta none.
 19, amenorrhœa, 14 No murmurs at base clearly distinguishable.
 18 days. 18 Pulmonary artery. Aorta.
- 29 W. Ploughman, 1 Aorta? Carotids. Apex.
 17, eryth. nodosum. 12 Pulmonary artery. Aorta none. Apex.
 26 days. 26 Pulmonary artery. Apex.

- 30 Mary Ward, 17, acute rheumat. 12 days. 1 Base none. Apex.
2 Base none. Apex fainter.
3 Pulmonary artery. Apex.
5 } Simple murmur in left part of the cardiac region. Carotids.
8 Vague } Musical murmur in region of the heart.
12 } Simple blowing murmur in do.
Other murmurs, as not noticed to have altered, are presumed to have remained.
- 31 Harriet Knight, 27, amenorrhœa. 40 days about. 1 Pulmonary artery.
26 Pulmonary artery loud and blowing. Aorta faint, less blowing.
40 Murmurs at base remain, but indistinct.
- 32 Maria Gall, 23, anæmia. 7 days. 1 Pulmonary artery. Aorta none.
2 Base short, harsh, but fainter, not easily definable.
4 Same sounds generally.
7 Sounds generally continue, softer.

It may be worth while briefly to run over these sixteen cases in the same manner as the former series. The murmur, by the nature of the case, remained in the pulmonary artery in all. Eight (namely, 17, 18, 19, 20, 21, 22, 23, 24,) presented also a murmur at the apex and in the aorta; four presented one in the aorta as well as the pulmonary artery, (namely, 25, 26, 27, 28,); in two, the apex and pulmonary artery were the situations in which murmurs were audible (29, 30,); and in two (31, 32,) the murmurs were so faint that no accurate description could be given of their situations.

For reasons already stated it would be unfair to draw any conclusions as to the comparative frequency of different murmurs, from these thirty-two cases; but there is a point of considerable interest in connection with this subject that they may serve to illustrate, which is, the date of the commencement of the murmur in the pulmonary artery compared with that of any other murmur arising during the progress of the case.

The murmur in the pulmonary artery was the first to be developed in four (namely, 25, 28, 31, 32). In none of these did a murmur subsequently develop itself at the apex. In truth, they were slight cases. Again in three (5, 11, 15,) the murmur was heard at the base of the heart for some days before it could clearly be made out in the pulmonary artery, in which, indeed, there was reason to suppose that the murmur did not exist in this artery.

In five cases a murmur appeared at the apex (10, 12, 20, 29, 30,) before it was detected at the base at all.

In the remainder, comprising 20 cases, (1, 2, 3, 4, 6, 7, 8, 9, 13, 14, 16, 17, 18, 19, 21, 22, 23, 24, 26, 27,) the murmur in the pulmonary artery was either the only murmur developed at all, (as may have happened in case 1,) or else was developed simultaneously with murmurs in other parts, which, for the present purpose, it is needless to particularise; or lastly, (as in cases 2,

16,) though the murmur could not be defined to be in the pulmonary artery just at first, yet the result of examination, when the murmur had become louder, gave reason to believe that the sound was audible in that situation, not from change of place, but from increased intensity merely. It appears, then, that in the 12 cases which give any means of judging, the murmur was developed in the pulmonary artery first in 4 or one-third. To this we shall have occasion again to refer.*

The cases on which these observations were made may be divided, in respect to their nature generally, under two heads. Omitting mention of three cases which do not readily fall under either of the proposed subdivisions, namely, one of rubeola 9, of fever 14, and of the effects of old rheumatism mixed up with present functional disturbances (24,) (33,) (34,) we shall have 29 cases remaining for this investigation. They fall easily enough under the two heads of rheumatism and anæmia, and its kindred maladies.

Rheumatism,	1, 4, 5, 6, 7, 8, 10, 11, 12, 13, 15, 16, 17, 18, 19, 20, 21,	
	22, 23, 25, 30,	=21
Anæmia, &c.	2, 3, 23, 24, 25, 26, 28, 29,	= 8
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		29

Of the anæmic cases but one opinion can be entertained that the murmurs audible in their hearts would some time or other altogether cease. Indeed in two (2, 3,) the murmurs were fairly watched out. In six the murmurs continued (26, 27, 28, 29, 31, 32,) after an observation of about 18 days. On the average, the other two gave no murmur on auscultation after about 11 days.

The examination of the cases of rheumatism is of far greater interest. Of these cases there are 21, of which 12 had murmurs removed, and 9 had no murmurs removed. Of the 12, 5 (1, 4, 5, 6, 7) had all the murmurs entirely removed, and the observation extended over spaces of 14 days, 2 years, 52 days, 64 days, and one year respectively. Of the 16 now remaining, the average length of observation was nearly the same in the 2 classes into which they may be divided, namely, in the 7 who had murmurs removed (8, 10, 11, 12, 13, 15, 16,) about† 29 days; in

* We would claim some higher consideration for the tables than that of merely serving as a basis for the above calculations. In the collection of the cases we were guided by a sincere desire to understand the meaning of the often recurring sound. To their careful examination we invite the reader, as the best proof that that desire of reaching the truth at last was never lost sight of among the varying phases which any single case might present. Should the few next years furnish us with facts sufficient to contradict these, we will not fail to acknowledge our error. At present we are sure that these are facts, which as yet time only augments, and we cannot, if we would, resist the conclusions which they have forced upon us.

† This average is too low for the actual state of things as registered in the tables,

the 9 where no murmurs were removed (17, 18, 19, 20, 21, 22, 23, 25, 30) about 28 days.

From these facts the following inferences seem naturally to arise. *First*, that a murmur may be heard in the pulmonary artery in many cases of anæmia and its kindred maladies, as also in acute rheumatism, which murmur, there are good reasons for concluding, not to arise from organic disease, as well on account of the variable nature of the murmur itself, as most conclusively on account of the rarity of disease of the pulmonary valves.

The *second* inference is, that the existence of a murmur in the pulmonary artery gives grounds, in some cases, for presuming that murmurs audible elsewhere in the same heart will disappear; in fact, that they do not depend on organic lesion of the valves to which they are referred. This statement will need a little farther exposition. And, *first*, as to the cause of murmurs generally. If they are not owing to organic changes, to what are they to be referred?

Whatever be the cause of the murmur being produced, the way in which the cause acts is by setting the blood in a state of vibration. The tones thus produced, whether in the blood-vessels or the blood itself, constitute, in all its varieties, what we call a murmur. And just as a wire may be fixed so as to vibrate on the least impulse, and continue long in that state of vibration, or to require a strong and frequently-repeated impulse to establish and maintain that state; so is it with fluids, and, what concerns us more immediately here, with the blood. The mere propulsion of this fluid from the ventricles into the large vessels, and its movement along the vessels, arterics, or veins, may suffice in some cases to set it in vibration,—to produce, in fact, a murmur. And this happens, as well shown by Andral,* especially in those cases where the blood is of extreme tenuity. In other cases, the blood requires more violent disturbance to throw it into vibration, such as is effected by the projection of a rigid valve into the stream, or by the sudden regurgitation of part of the stream, as in the case of imperfect closure of the aortic valves. Here, then, are the two cases;—the attenuated blood vibrating from a common cause, insufficient to affect healthy blood; and blood of a normal density vibrating from a superadded cause.†

but the addition of a period of five months to the observation of case 13, (26), though it represents that case correctly as regards the observations that were made, probably does not fairly represent the actual state of the case, as the murmur may have disappeared months before during his absence from the hospital in the interval. While, therefore, we reckon this case as one where a murmur was removed, we are compelled to underrate the time required for its removal, and thus deprive ourselves, in some degree, of the pleasure of showing that a little longer observation would have in all probability altered the position of some cases from the second into the first class.

* *Hæmatologia*, pp. 52, 54. See also on this subject a paper by M. La Harpe.

† *Archives Generales de Medecine*, Aout, 1838, Pt. iii.

Insisting on the fact of the pulmonary valves being generally free from disease, murmurs referred to this situation must be explained on some other supposition than that of structural change. On the exact mode of production of this vibration there is no space here to speculate. The peculiar theory which any one may advocate is a step anterior to that with which we would commence, namely, the audible effect of these causes, whatever they may be assumed to be. We may suppose the ventricle to be contracting with unusual force, with unusual rapidity, to be temporarily, (for the variable nature of the murmur will not let us suppose it permanently), dilated, or affected in any way so as to throw the blood into greater vibration; or the blood itself may, by its tenuity, be more susceptible of vibration. There may be any cause but permanent structural change in action.

But before applying these conclusions to the other orifices of the heart, we must again refer to the table of cases, for we can apply them safely only under certain restrictions. It has been already noticed that the murmurs did not begin at the same time at all the situations at which it was eventually audible. In the majority the murmur began at the same time in more than one situation, and so far this is favourable. For if a murmur arises in any part of the heart except at the pulmonary orifice during acute rheumatism, and subsequently a murmur appears at this latter situation, we must look on that case in a less favourable point of view than what we would on a case in which they were all developed simultaneously; and this will be the more necessary, if, in addition to the attenuating effects of rheumatism on the blood, (which reduces its solids in the same way, though not to so great an extent, on the average as does chlorosis,)* venesection,† which produces analogous effects on this fluid, have been employed.

With this restriction we may apply what has been said of the pulmonary orifice, to the other orifices of the heart. It is *possible* that the murmurs heard in other parts of the cardiac region may have their origin in the same or similar functional disturbances in which it is *probable*, nay, almost certain, that the murmurs of the pulmonary artery take theirs. On this question, or recurring to the words of our second inference, what grounds there are for presuming that a murmur co-existent with one in, but referred to any other situation than, the pulmonary artery, may ultimately disappear, the above tables may throw some light.

It is true that of the first sixteen cases only seven had all the

* Simon, *Medizinischen Chemie*, ii. 175, 208.

	Solids.	Fluid.
Healthy standard,	210	790
Rheumatic blood, average,	194	805
Chlorotic do. do.	172	827

† Hope, *op. cit.* p. 100 and p. 106. M. Hall, *Med. Chir. Trans.* xvii. p. 270, et seq. G. O. Rees, *Med. Gaz.* vol. xxxv. p. 849.

murmurs fairly watched out, (the phrase accurately expresses the process,) but in the whole of them changes were witnessed in the murmurs, and chiefly in those murmurs which, judging from their situation, were less likely to prove of a functional origin than those in the pulmonary artery. Let us look at the recorded auscultations of any cases which have been watched for a considerable time, till death has given an opportunity of confirming the diagnosis of valvular disease. The murmur on which the diagnosis was founded may have varied in intensity, it may have varied in character, from a musical have become a blowing sound, or the reverse, but it will never be found to have varied in situation. It may perhaps have been inaudible in its own situation, owing to a tranquil state of the circulation, but never will it be found to have left its own, and taken up, so to say, a new position.

It cannot be too strongly urged, for on this fact all the practice of auscultation is based, that each valve is a distinct centre of disease, and that the signs of the disease of each valve show themselves at particular places. If a murmur is heard one day at the apex, another day at the base, and another not at all, or perhaps at both places, clearly, considered in themselves, these murmurs are to be looked upon in quite a different light from one which is always referred to the same situation. May be they are all alike functional, but they cannot all depend on structural changes of the valves. Such can only be the case with the stationary murmur. And if, of these variable murmurs, one may be exchanged for another, why may not both be simultaneously removed? And if, of more murmurs than one in the same heart, one be manifested in the pulmonary artery, and be almost to a certainty independent of structural change; is it not at least possible that the murmur at the apex, or that in the aorta may be produced by the same or a similar cause to that in the pulmonary artery. The existence of a murmur in this artery shows that there is a cause in operation, independent of organic disease, sufficient to produce a murmur, and gives *some* grounds for presuming a functional origin even of such murmurs as have not yet by their variations already declared the nature of the cause which has produced them.

It is not without the fullest sense of the frequency of heart affection in acute rheumatism, that we venture on these remarks. To one conversant with hospital practice it will be unnecessary to apologize for almost complete ignorance as to what ultimately becomes of those who are discharged with the symptoms of heart disease after acute rheumatism. Enough if we have grounds for a hope, where our real information could give us no expectation, of the ultimate recovery of some portion of them.

It would be wandering too far from the proper subject of this essay to do more than point out generally why the subjects of acute rheumatism should be particularly liable to functional mur-

murs of the heart, or to collect authorities who have doubted the frequency of heart disease as a consequence of such affection. For after all, we have to deal with single and acute cases, to which general rules are rarely applicable, and, I fear, even on the authority of Chomel,* to encourage a doubt, in a single case where a murmur is heard, of deposition of lymph on the valves, when the time for cure is so short, the consequences so terrible, and the deposition of lymph, to all demonstration, so frequent.

Perhaps, too, after all, this murmur in the pulmonary artery may seem trivial, but as the characters that distinguish organic from functional murmurs are to be sought in the variable nature of the latter, and the recognition of this pulmonary murmur gives a means of distinguishing a difference where we should have presumed an identity; further, as murmurs are more commonly heard at the base than at the apex of the heart, and consequently assistance in this quarter is so much more valuable for diagnosis; lastly, as the murmur in the pulmonary artery, as already shown, generally outlives all the rest, therefore, as in the most important particular, in the greater proportion of cases, and at an earlier period, information can be drawn from this sign; that surely cannot be trivial to appreciate which nothing more than common tact, than common industry are required.

Our means of diagnosis between functional and organic murmurs of the heart are derived from numerous sources; but it is rather from the meaning of them all together than from the import of any one singly, that we draw our conclusions. That the general symptoms diagnostic of functional affections of the heart have not been here spoken of, must not in any way be considered as a proof that we underrate them. The above remarks have been confined to the physical diagnosis, though a more generally interesting, and perhaps a more useful essay might have been written on the means of diagnosis which the constitutional symptoms offer, for indeed they are many enough and variable enough to require a long exposition. The present diagnostic character is put forwards, not as demanding exclusive attention, nor disparagingly of the information supplied by other symptoms, but merely as one other sign; its existence we have endeavoured to show, and the field in which it may be useful, not as sufficient always whereon to found a diagnosis, but at least as valuable as many on the grounds of which we are in the daily habit of presuming, and by its presence confirmatory where not conclusive for a favourable, rarely, if ever, for an unfavourable prognosis.

* Chomel sur le Rhumatisme, p. 297. The comparatively greater frequency of base than of apex murmurs must be a fact familiar to auscultators. But the traces of endocarditis are more common on the mitral than the aortic valves. (Rokitansky, Pathologie, i. 439.) The difference must therefore be set down to some other cause than permanent organic affection of the valves, arising from endocarditis.

